



Getting Started with Prefab

ELECTRI **INTERNATIONAL**

Research and Education for the Electrical Construction Industry

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Industrialized Construction



Industrialized Construction - The industrialization of construction is the process through which construction aims to improve productivity through increased mechanization and automation. The process commonly involves modularization, prefabrication, preassembly, and mass production



Merck has released an initiative for all construction to be 80% fabricated offsite by 2025

GES Expedition25

Vision: Safely and effectively deliver >\$15B in capital to enable 1B more patients served.



Fortify our Future



Ways of Working:
Mindsets and Behaviors



Investing for Life



2025 Strategic Imperatives

Protect Safety First, Quality Always
0 Incidents, 0 Defects

Build our Future - Workforce and Facilities
*New Design Thinking and MPS Capabilities
Agile Solutions with Digitally Enabled Results*

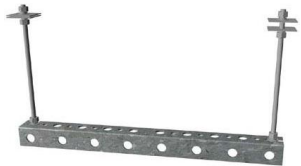
Transform our Business
40% Less, 80% Offsite - Capital Effectiveness



Comparing work in the Shop to the Field

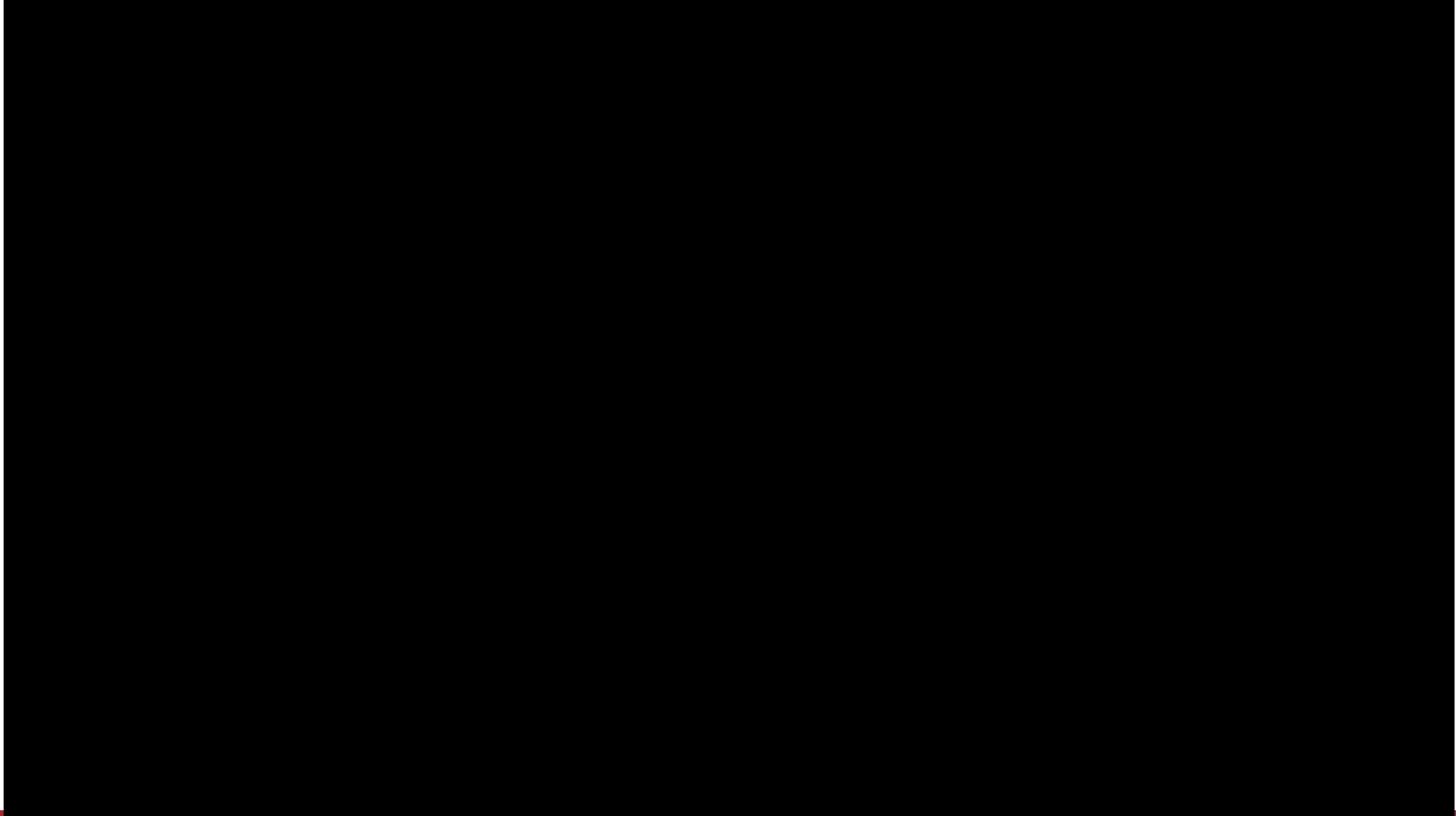


	Shop	Field
Labor Rate	\$75/Hr.	\$110/Hr.
Single Clevis Hanger	3 Minutes	10 Minutes
Single Tier Trapeze Hanger	6 1/2 Minutes	17 Minutes



Advances in Digital Fabrication

TigerStop and RazorGage

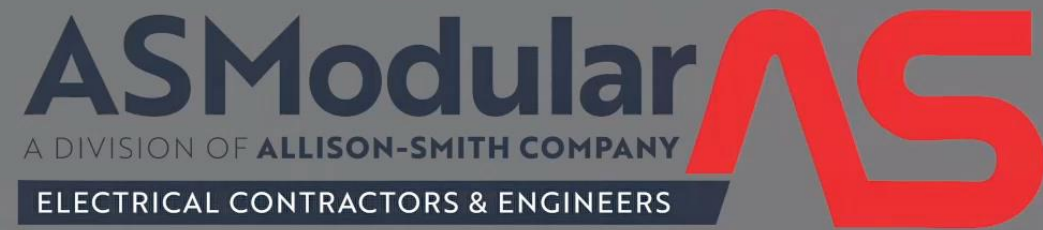


Advances in Digital Fabrication

TigerStop and RazorGage



Standardization evolves into Productization

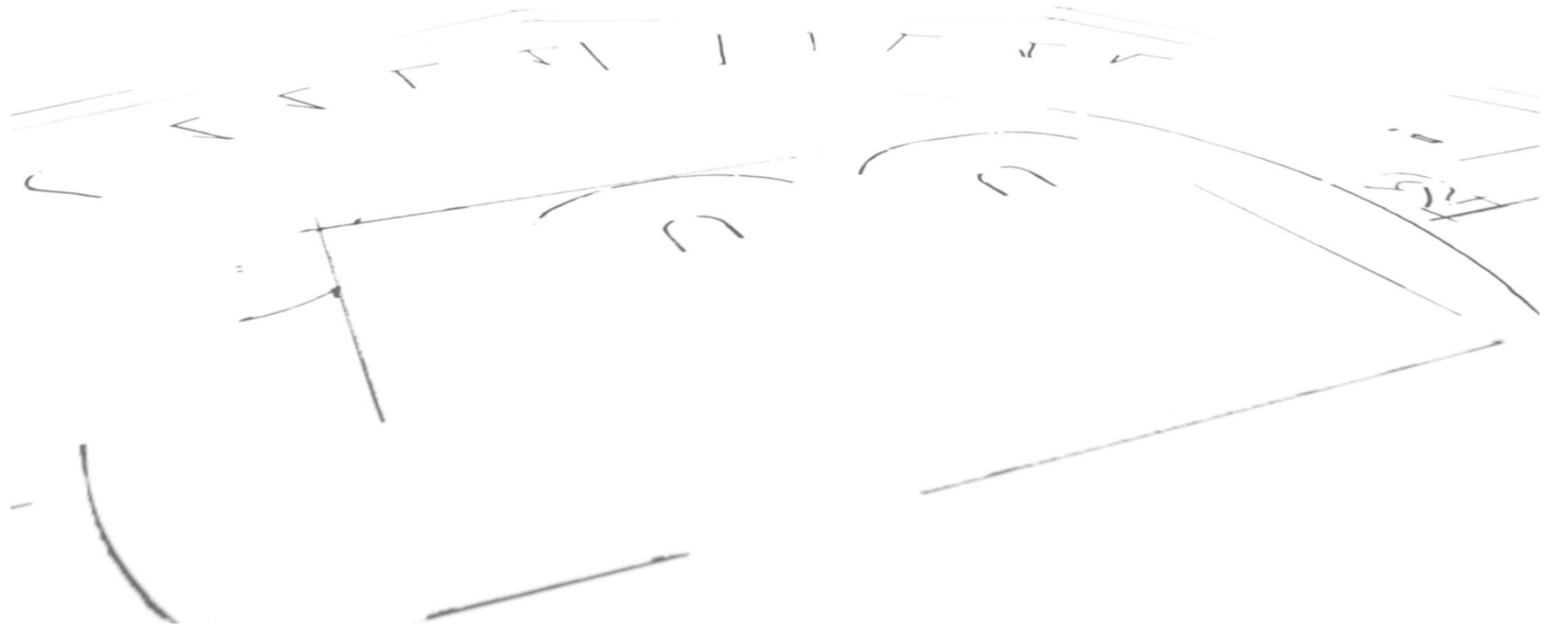


Panel Builder Program



Conduit Bending





What are others doing?

Xexcellerate®

**CONSTRUCTION
MANUFACTURING**

**TEMP POWER
PANELS**

UNDERGROUND

**TRAPEZE
HANGERS**

**IN-WALL ROUGH IN
BOX ASSEMBLIES**

CONDUIT

**ELECTRICAL
ASSEMBLIES**

CABLE TRAY

CABLE / WIRING

KITTING



[DOWNLOAD SPEC SHEET](#)

**UNDERGROUND
HORIZONTAL
DUCTBANK**

APPLICATIONS

<https://www.excelleratemfg.com/>





The Competition is Evolving



RISE Modular

6,359 followers

1h · 🌐



#WeAreHiring #ConstructionJobs #ManufacturingJobs
#Carpenter #Electrician #Plumber #Journeyman
#FortLiftOperator #HVAC #Painter #Framer #Jobs
#TogetherWeRISE

It's always 70 degrees at RISE and we are hiring!

If you are a t-shirt wearing drywaller, plumber, electrician, carpenter or an experienced construction tradesperson, RISE may be the place for you.

- Highly competitive wage and benefits package with full healthcare coverage
- \$1,500 signing bonus
- Climate-controlled manufacturing environment
- Safer, healthier work environment
- Ergonomic workstations

Revolutionizing construction with commercial volumetric modular and YOU!



Offsite Construction

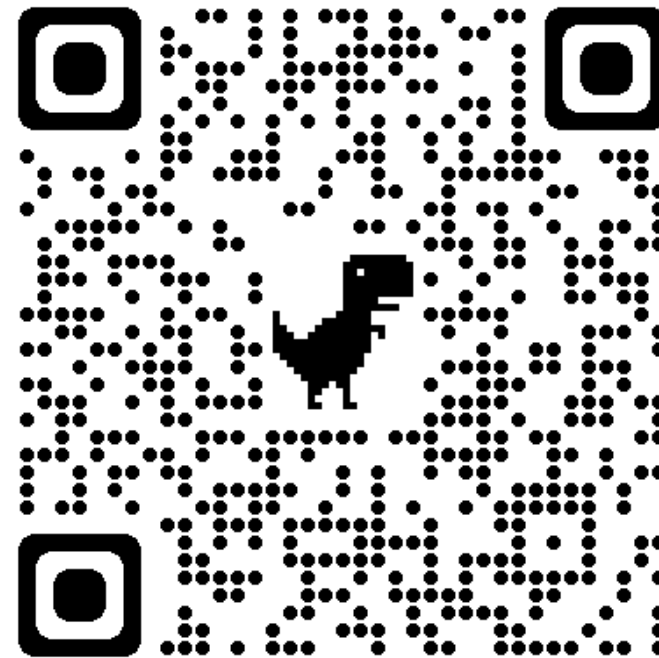
Benefits of Offsite Construction:

- Safer working conditions – fewer ladders, less silica exposure, less tools used overhead, exposure to weather, etc.
- More productive
- Adds certainty to the schedule
- Reduction of Waste
- Improved Quality
- Controlled training environment
- Etc.

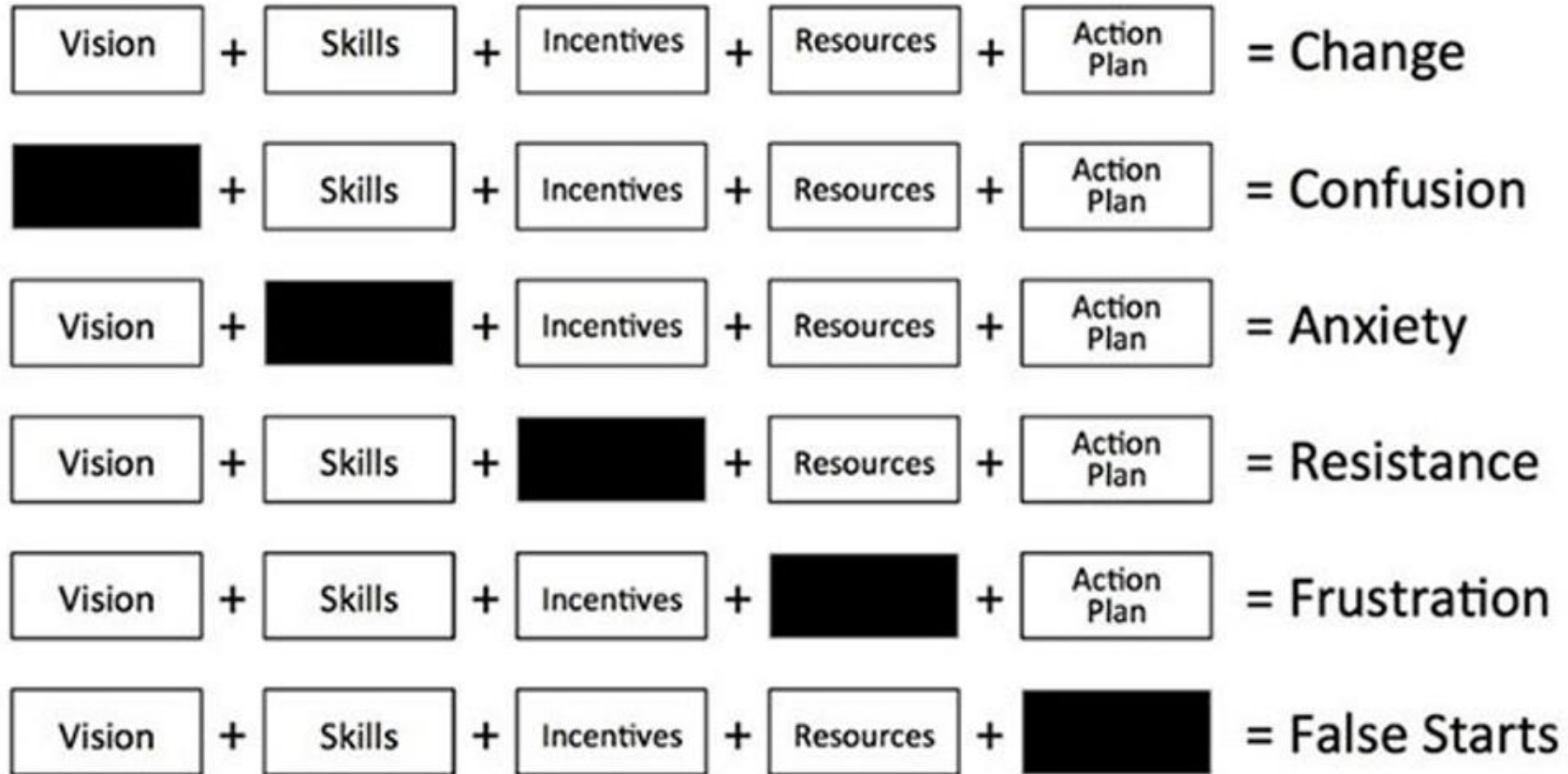


Working with IBEW

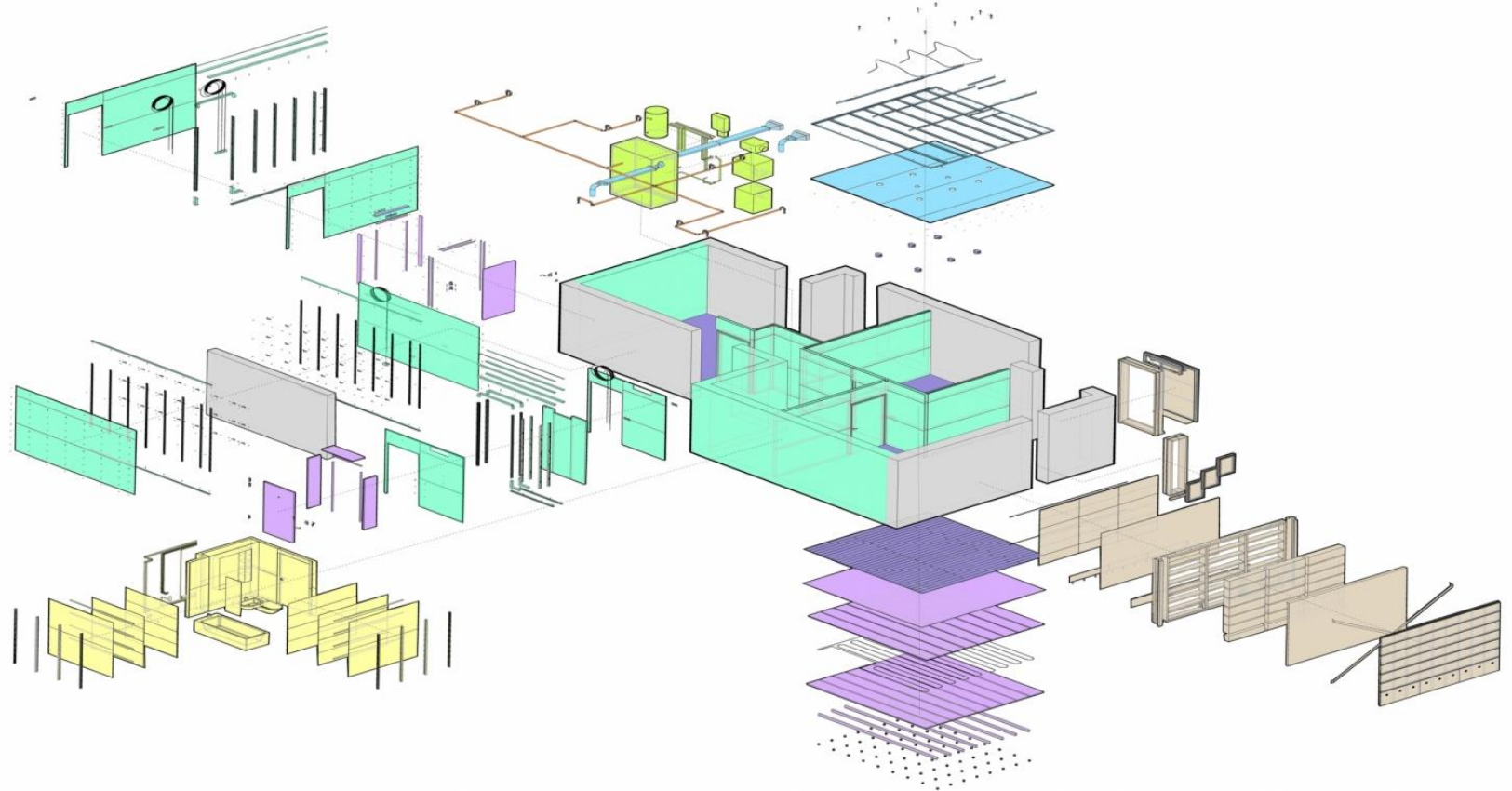
- Yellow Tagging/Labels are critical to their ability to prefab – How do we bring the IBEW and electrical contractors opposed to portability along with us? We are playing with a significant disadvantage.



Managing Complex Change



- Offsite
- Kitting
- Prefab
- Panelized
- Modular
- Volumetric



Offsite Construction (Off-Site)

Most companies get started with some very basic concepts. That transfer the same job-site processes into a warehouse type environment.

- Prep
 - Unboxing, Minor Assembly, Testing
- Multi Wire Reel
 - Combine multiple wires to a single reel to the pull length
- Bends
 - Conduit bending
- Packaging
 - Grouping materials and tools together based on what and when they will be needed on site
- Logistics
 - Warehouse staging, shipping and job staging



Prefabrication (Pre-Fab)

Traditional on-site methods of assemblies that have been moved into a warehouse or manufacturing facility.

- Assemblies
 - Conduit
 - Cable Tray
 - MC Whips
 - Panels
 - Equipment
 - Boxes
 - Hangers
- These assemblies typically have multiple materials and manufactured items that are put together in the shop and delivered to the jobsite as components

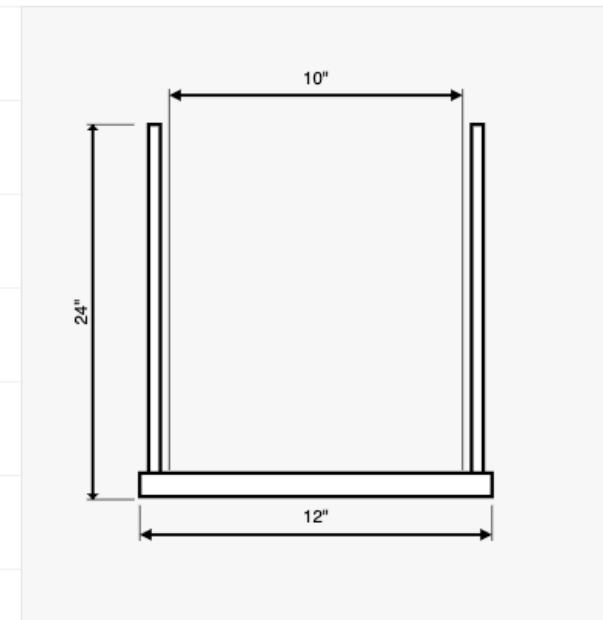


Construction Manufacturing (Con-Mfg)

Transformation of on-site methods of assembly into manufacturing processes of standardized assemblies to produce higher volumes that can be introduced during design, preconstruction and or sold to 3rd parties.

Standardized assemblies or DFMA are often the same assemblies but with limited configuration options.

Strut Profile	1-5/8" x 1-5/8", 12 Gage
Strut Length	12"
Strut End Finish	Cut
Rod Length	24"
Rod Diameter	3/8"
Number of Tiers	1
Quantity	



Where is Construction Going - DFMA

Is the combination of two methodologies; Design for Manufacture, which means the design for ease of manufacture of the parts that will form a product, and Design for Assembly, which means the design of the product for ease of assembly.



It all starts with the People



- You have to get buy-in from the field. They need to be apart of the solution.
- Get the right people in the right place. From the field side get the person who is thinking outside of the box who is solving problems in untraditional ways. these are great guys to start the foundation in the shop for prefab because they're going to encounter different situations for different projects, and they'll find out-of-the-box solutions.
- Weekly Foreperson Prefab Meetings (15 minutes) to build comradery and open line of communication
- Getting Foreperson aligned early with their design



- Look at jobs with prefab in mind - Which jobs are going to be best for prefab implementation and to what level. Some jobs you will be able to prefab a lot more than others, set a criteria for levels of offsite construction. 1 (minimal) – 5 (Majority of job prefab).
- Select a good project, find a project that has a good GC that you trust and that understands the impact that the prefab will bring.
- Start small, start with receptacle boxes and MC for inwall, or lighting whips. Develop and fine tune your process on the easier prefab opportunities, as your process improves increase the amount of prefab that you're doing.
- Do not be afraid to fail some of the biggest improvements come from some of the largest failures. consider failing as part of the learning process, a failure is only a failure if you don't learn from it.

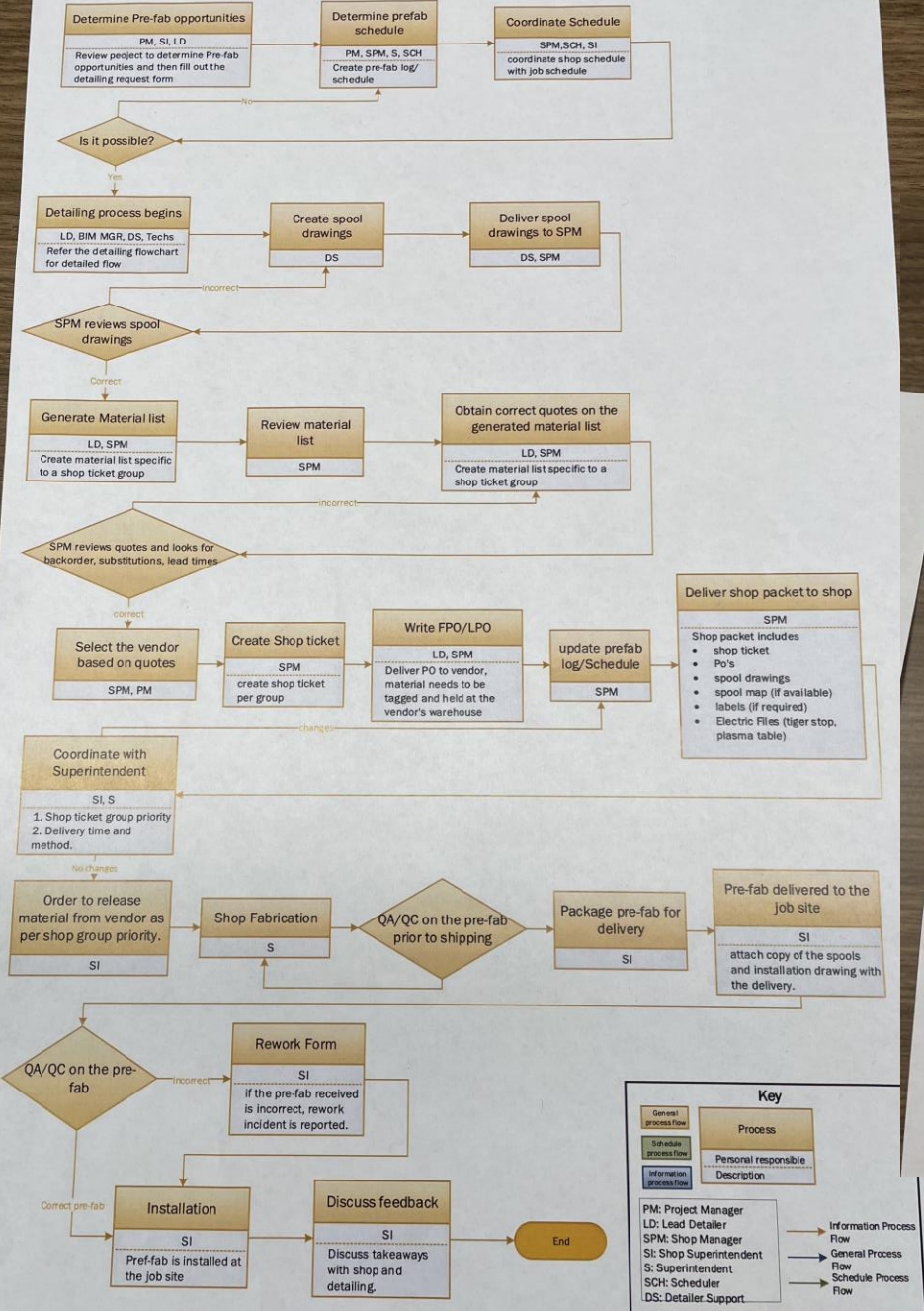


Process Mapping

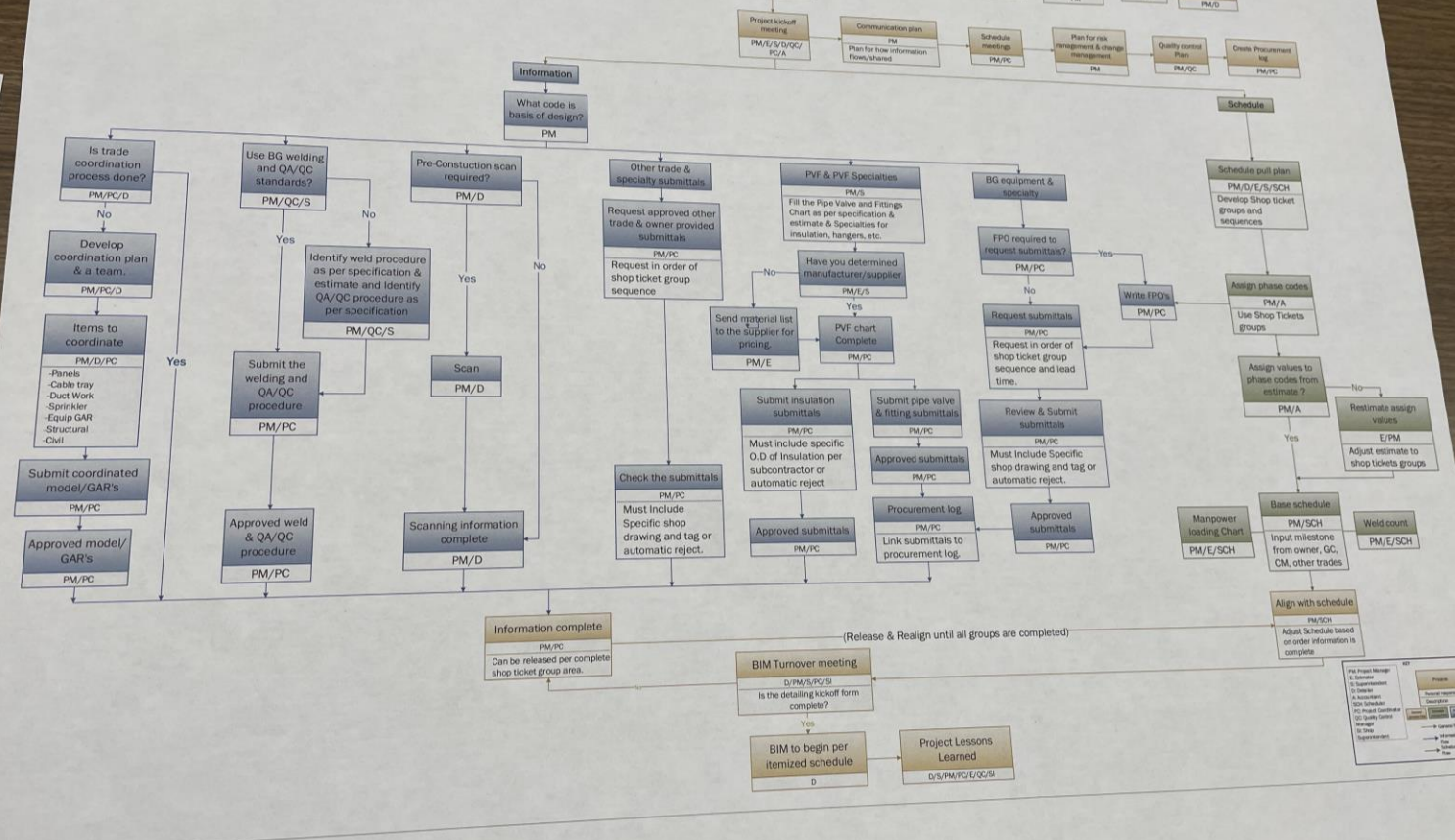


Process Mapping

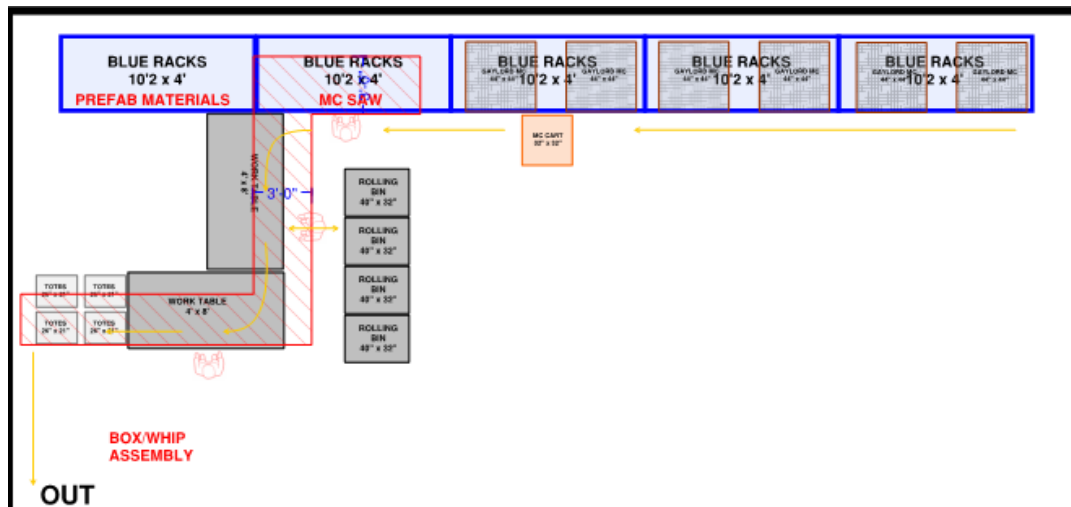
Shop Procurement Flow Diagram



Baker GROUP PM TO BIM FLOW CHART



BOX AND WHIP ASSEMBLY STATION



BOX AND WHIP ASSEMBLY STATION

DESCRIPTION-CUT MC AND INSTALL INTO BOXES, WIRE WITH PLUGTAILS AND PACKAGE IN TOTES.

TOOLS NEEDED AT STATION

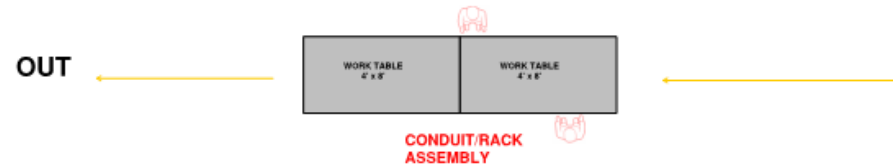
- SIDE CUTTERS
- FLATHEAD & PHILLIPS SCREWDRIVERS
- WIRE NUT DRIVER
- LINEMAN PLIERS
- WIRE STRIPPERS
- TRASH CAN

MATERIAL NEEDED AT STATION

- MC CONNECTORS
- WIRE NUTS
- 3 BOX BRACKETS
- EXPANDER BRACKETS
- TEK SCREWS
- ZIP TIES
- WHITE TAPE
- DUCT TAPE
- SHARPIES
- SHRINK WRAP
- TOTES AND LIDS



CONDUIT RACK BUILDING STATION



CONDUIT RACK STATION

DESCRIPTION-ASSEMBLE CONDUIT AND STRUT INTO CONDUIT RACKS OR BRANCH CIRCUIT ASSEMBLIES.

TOOLS NEEDED AT STATION

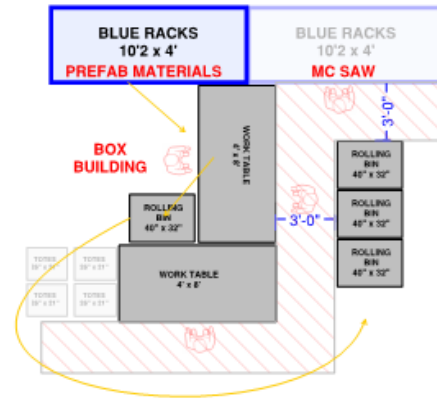
- TAPE MEASURE
- PENCIL
- SHARPIE
- PVC HEATER
- SOCKET SET
- IMPACT DRIVER W/ BATTERIES AND CHARGER
- ASSORTED IMPACT BITS
- FLATHEAD & PHILLIPS SCREWDRIVERS
- NUTDRIVERS
- C CLAMPS
- NEEDLE NOSE PLIERS
- LINEMANS PLIERS
- WIRE STRIPPERS
- WIRE NUT DRIVER

MATERIAL NEEDED AT STATION

- SHRINK WRAP
- TEK SCREWS
- 3/8" NUTS AND WASHERS
- 1/4" NUTS AND WASHERS
- COBRA CLAMPS
- 8-12P STRAPS



BOX BUILDING STATION



BOX BUILDING ASSEMBLY STATION

DESCRIPTION-PREASSEMBLE WALL BOXES WITH BRACKET, MUDRING, AND GROUND PIGTAIL.

TOOLS NEEDED AT STATION

- (2) 9V IMPACT DRIVERS W/ BATTERIES AND CHARGERS
- ASSORTED IMPACT BITS
- FLATHEAD & PHILLIPS SCREWDRIVERS
- WIRE NUT DRIVER
- CHANNEL LOCK PLIERS
- TRASH CAN
- LOCKNUT SOCKET
- LINEMAN PLIERS

MATERIAL NEEDED AT STATION

- BOXES
- MUDRINGS
- BRACKETS (REG, 3 BOX, & EXPANDING)
- GROUND PIGTAILS
- 1/2" & 3/4" CONNECTORS



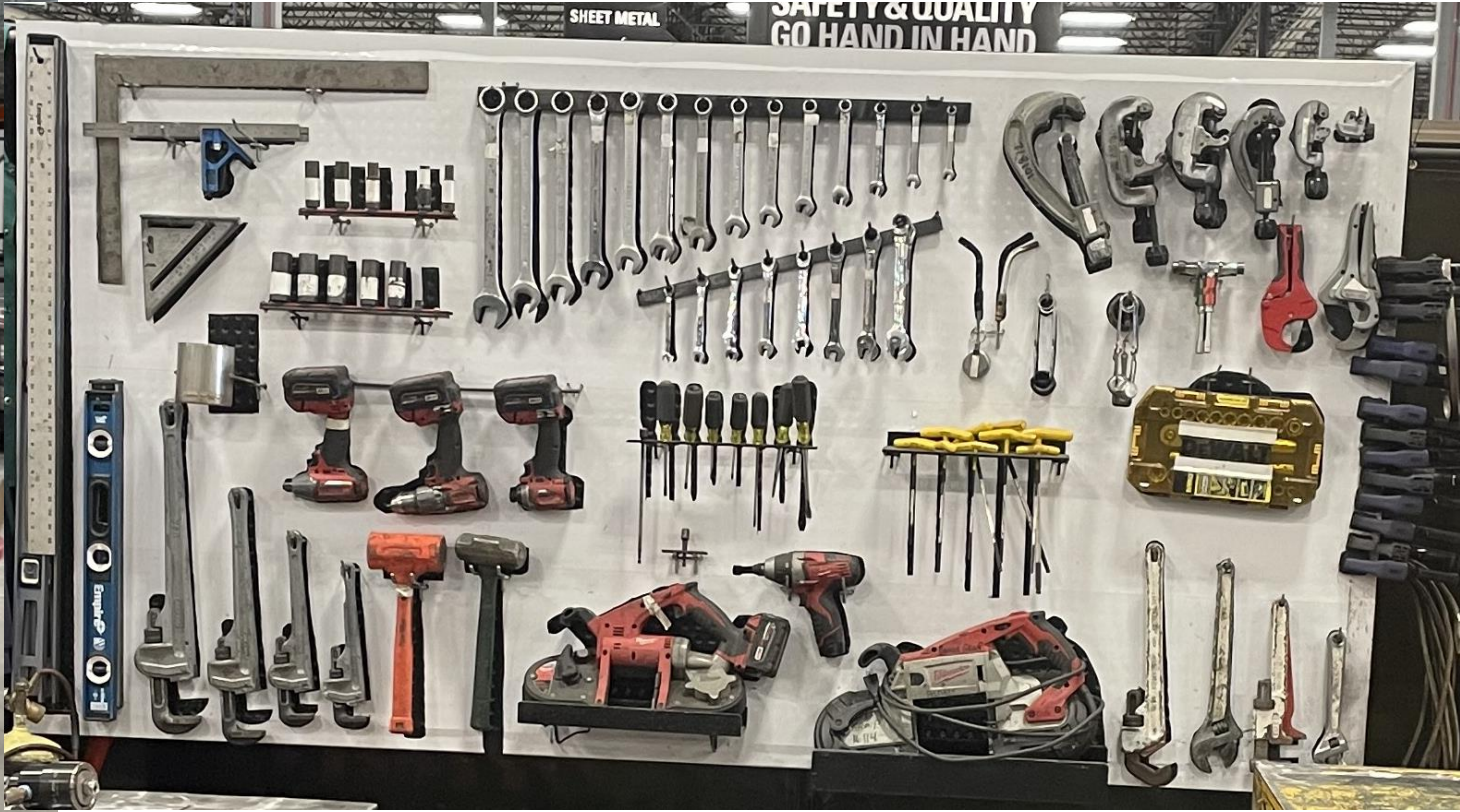
Workstations







Shadow Boards





Mophorn Computer Wire Stripping Tool 110V Copper Wire Stripping Machine 3000-8000pcs per hours Automatic Wire Cutter 1-9999mm Peeling and Cutting Machine

Brand: Mophorn

\$729⁹⁹

Pay \$40.56/month for 18 months, interest-free upon approval for the Amazon Rewards Visa Card

Brand	Mophorn
Material	Stainless Steel
Color	4.5 square stripping machine
Handle Material	Polyvinyl Chloride

About this item

- Cutting the line core cross section: 0.1-4.5mm²; Cutting Length: 1 - 9999 mm
- Stripping speed (/ h): L = 100mm, 3000-8000pcs / h (high yield)
- Appropriate stripping wire: PVC / Teflon / silicone cable / wire glass fiber
- Exquisite outlines, simple operation and maintenance, stable performance, fast speed, and high accuracy



Workstations (Cont.)



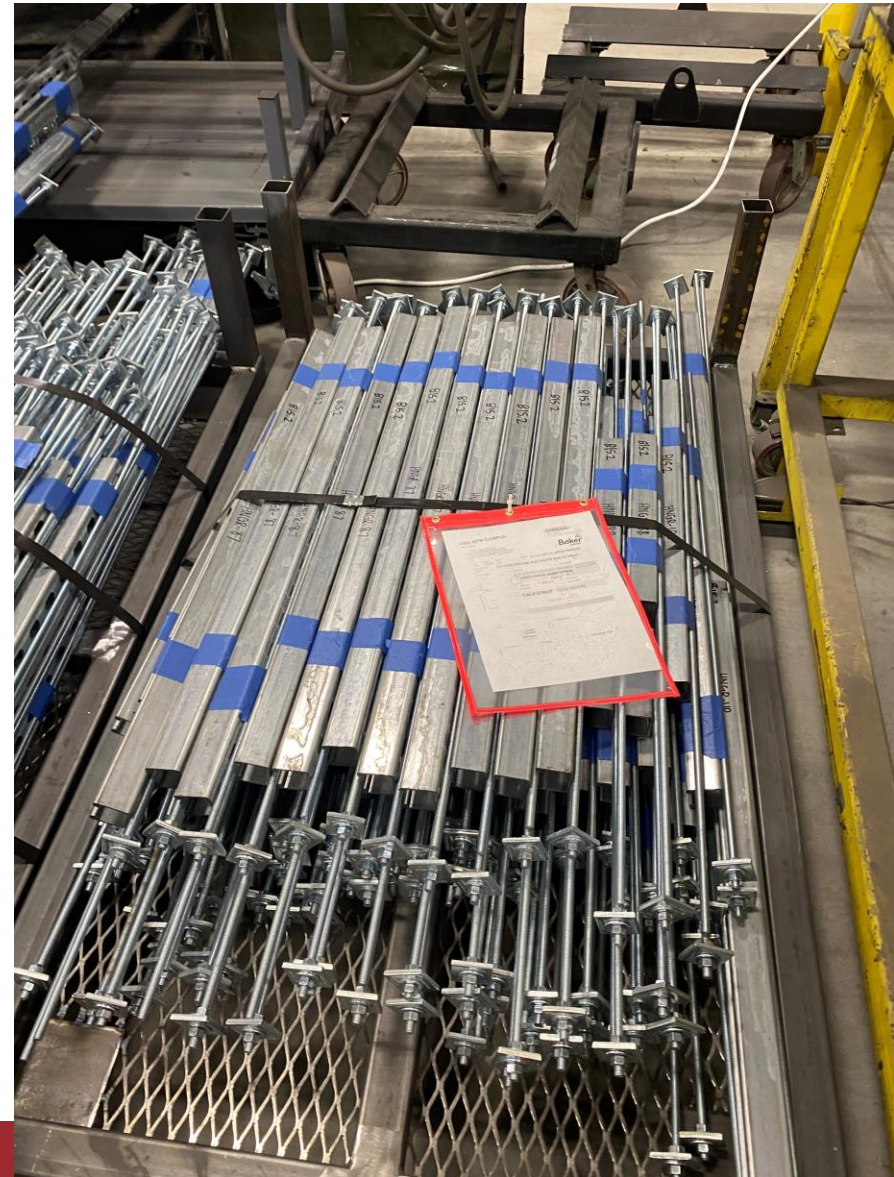
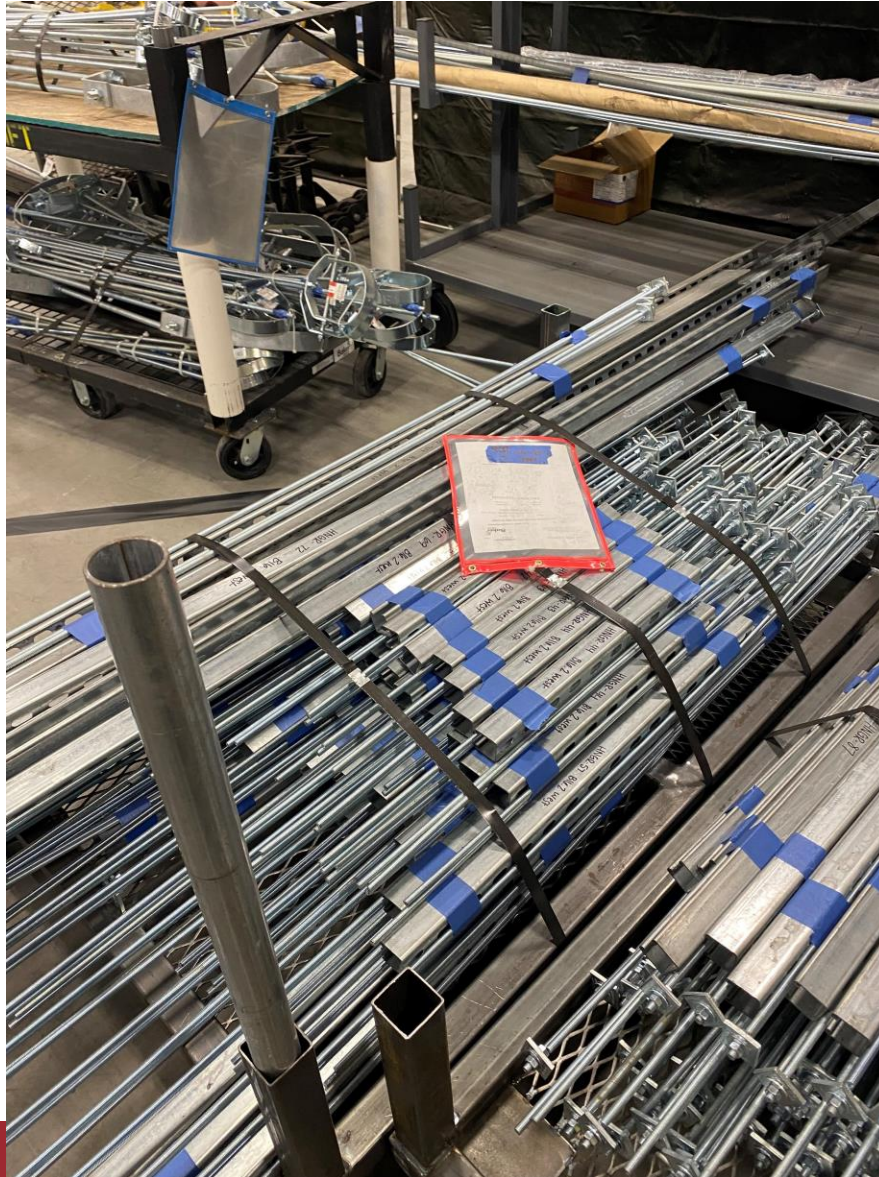
Storage & Handling (Cont.)



Storage & Handling



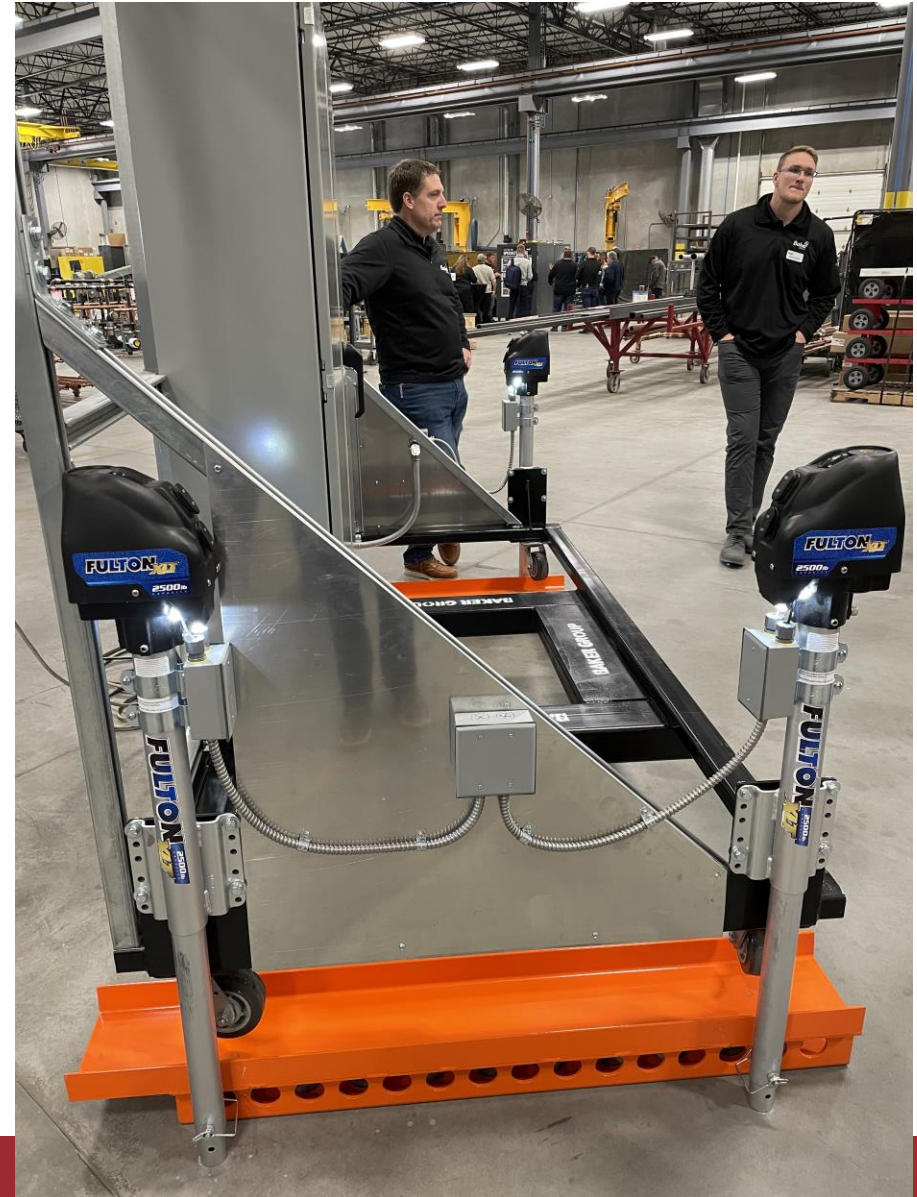
Storage and Handling (Cont.)



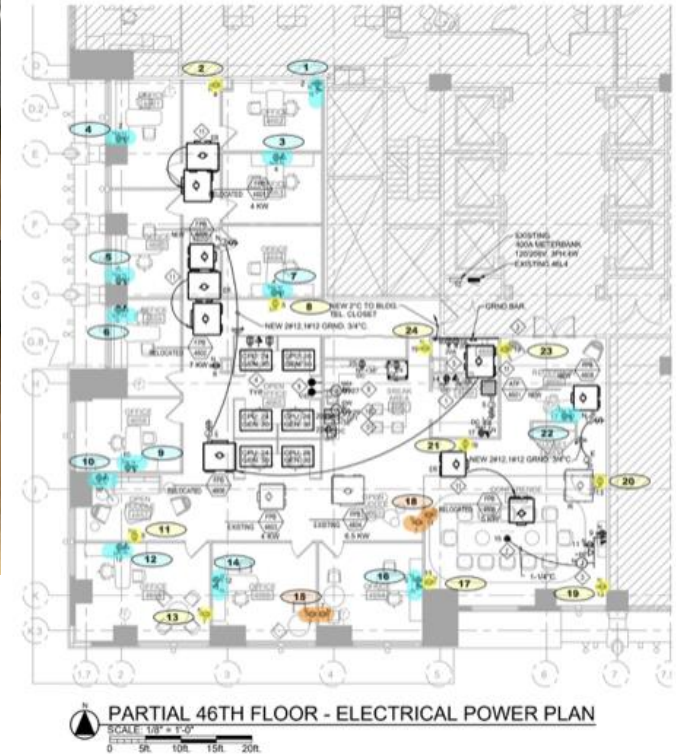
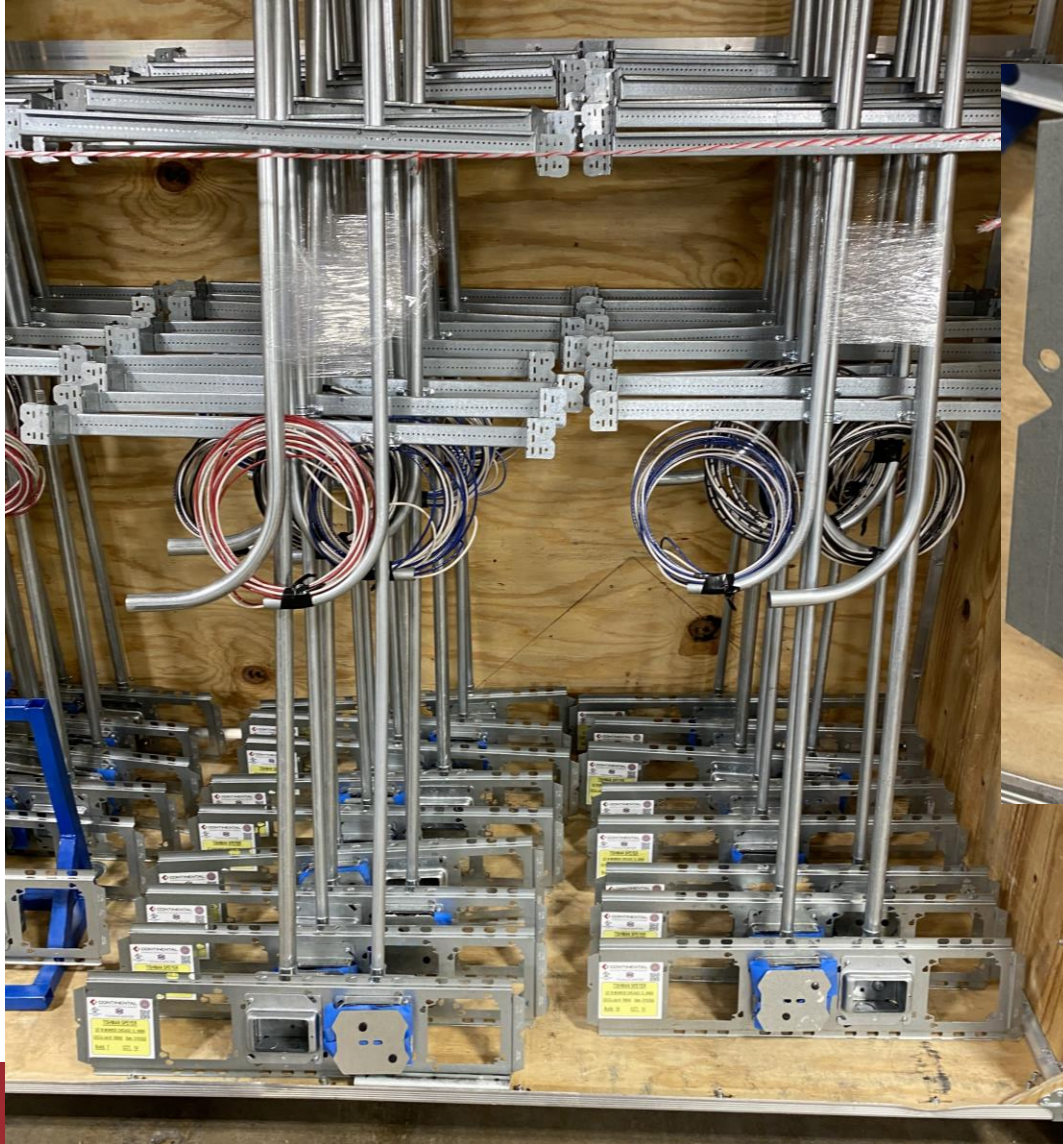
Storage & Handling (Cont.)



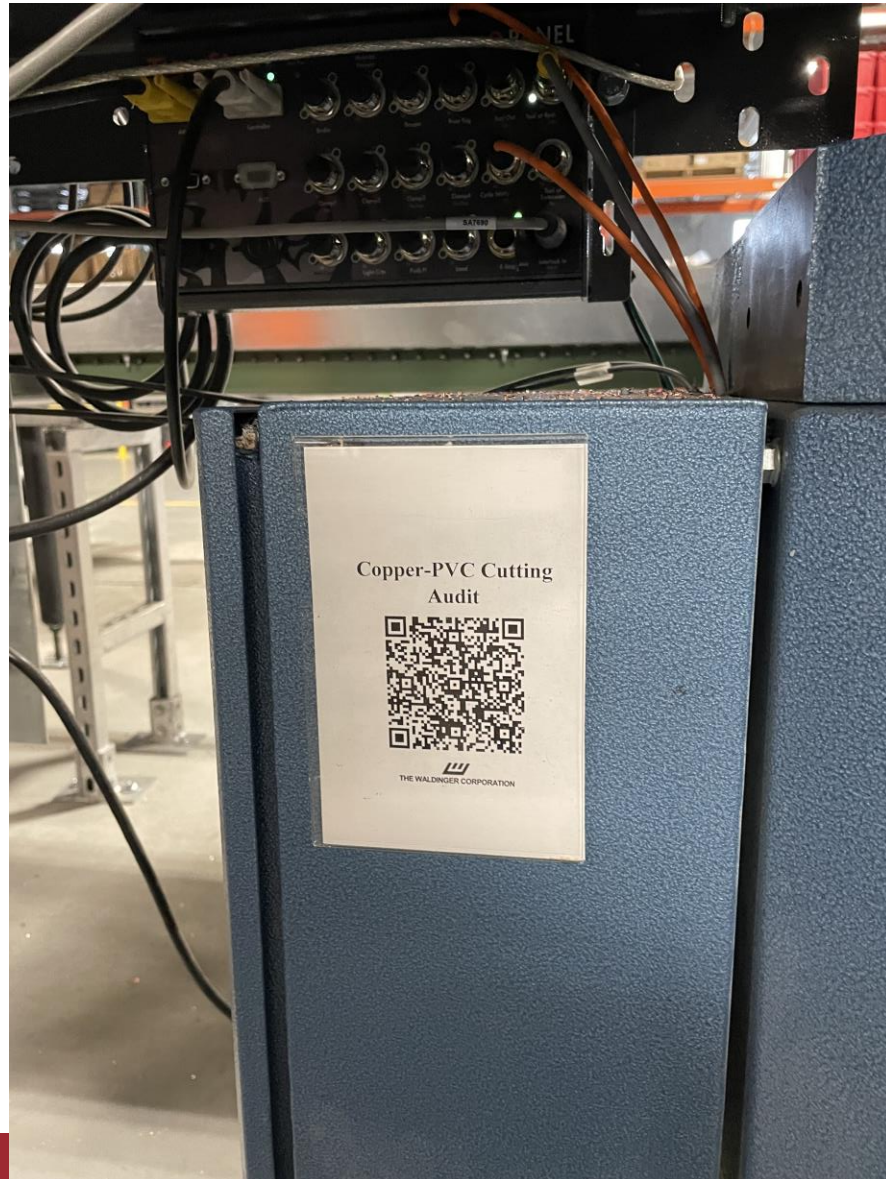
Storage & Handling (Cont.)



Standardization - Productization



Interesting Ideas





Buy vs Build

- Strut Hanger Pro - <https://www.struthangerpro.com/>

Product configuration interface for a Trapeze Bracket. The interface includes a navigation menu, a configuration table, a technical drawing, and a summary table.

Navigation Menu:

- Cut Strut
- Trapeze Bracket**
- Center Hung Bracket
- Clevis Bracket
- Loop Bracket
- Roller Bracket

Configuration Table:

Strut Profile	1-5/8" x 1-5/8", 12 Gage
Strut Length	24"
Strut End Finish	Deburred
Rod Length	36"
Rod Diameter	3/8"
Number of Tiers	1
Quantity	1

Technical Drawing:

Summary Table:

Number of Tiers	1	\$20.06
Rod Diameter	3/8"	MODIFY
Rod Length	36"	DELETE
Strut End Finish	Deburred	
Strut Length	24"	
Strut Profile	1-5/8" x 1-5/8", 12 Gage	
Quantity	1	



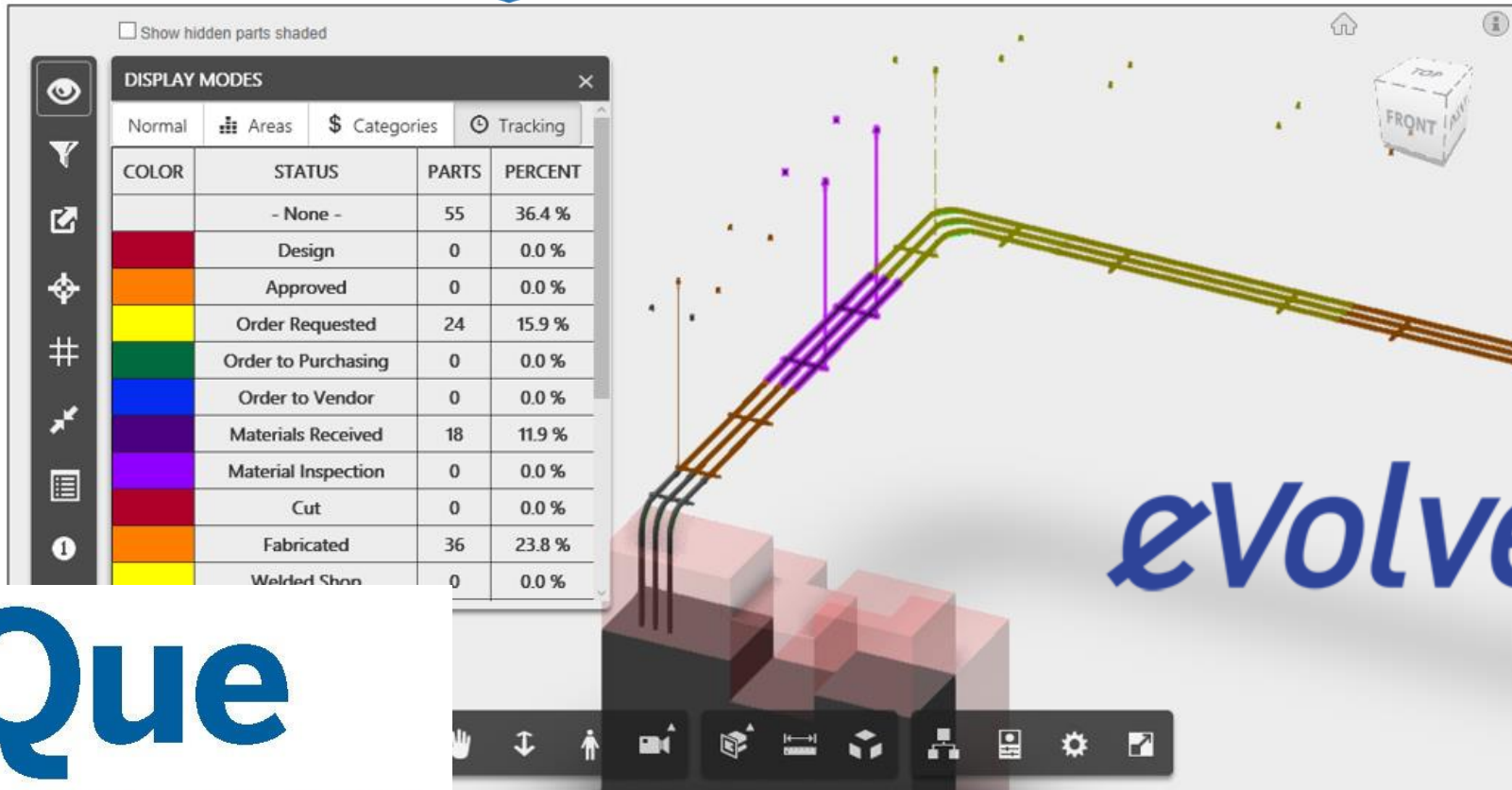
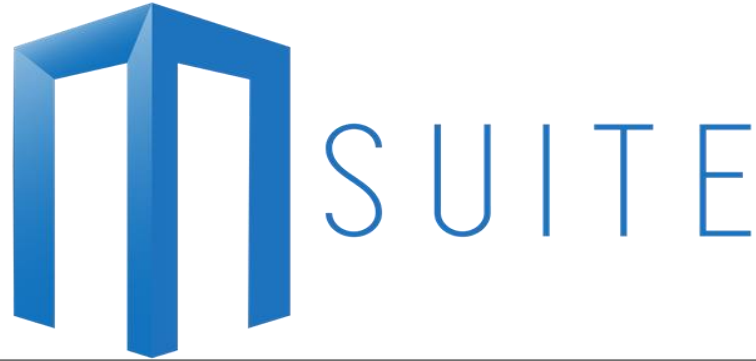
Technology



Viewing the Plans & Model in the Field



BIM/VDC



eVolveMEP



SysQue

THE DIFFERENCE IS REAL

Augmented Reality



Robotic Total Stations



Trimble



Leica



Sokkia



Topcon



2nd Generation Robotic Total Station – Rapid Positioning Systems



RPT600

- Range of 50m
- Autostationing™
- 300° of tilt for easy overhead measurements.
- Green laser: lets you measure without a prism on a wide range of surfaces.
- Retailers around \$19,000



360 Cameras



Insta360 ONE X = \$400



Ricoh Theta V = \$349



Garmin Virb 360 = \$799



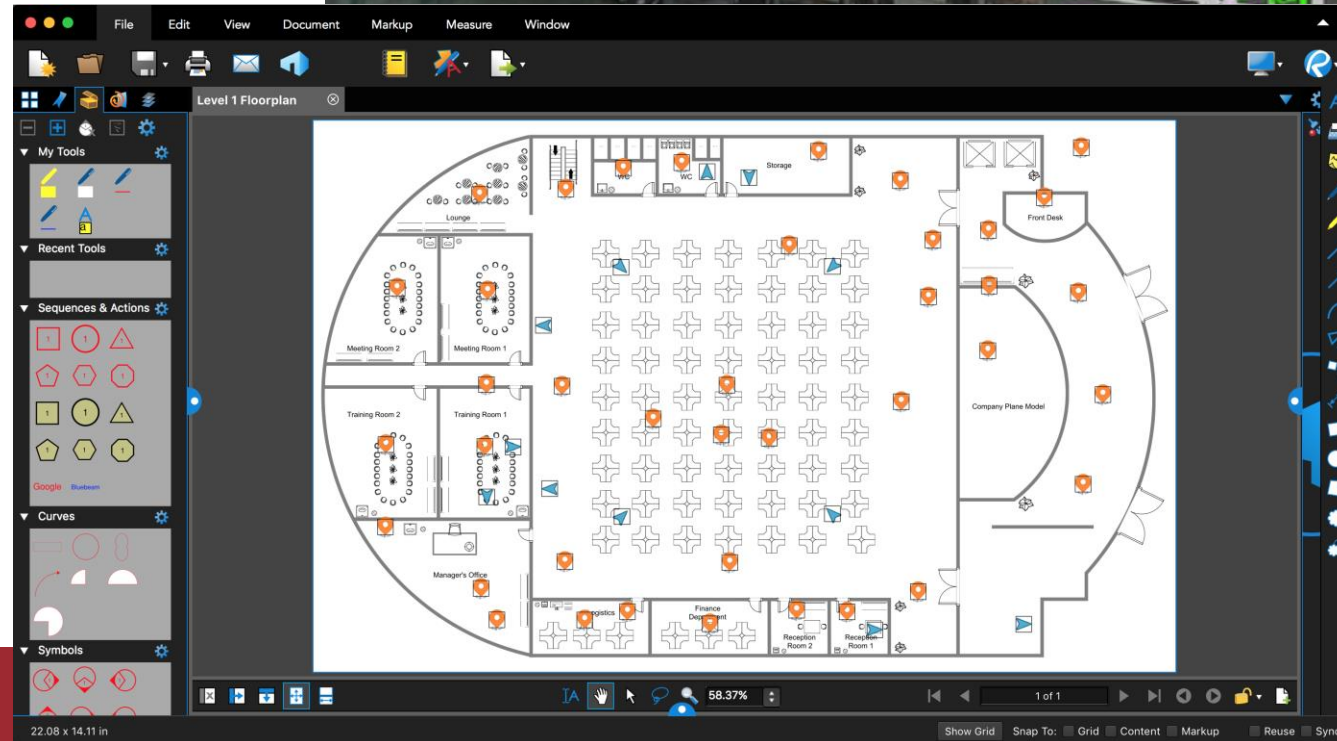
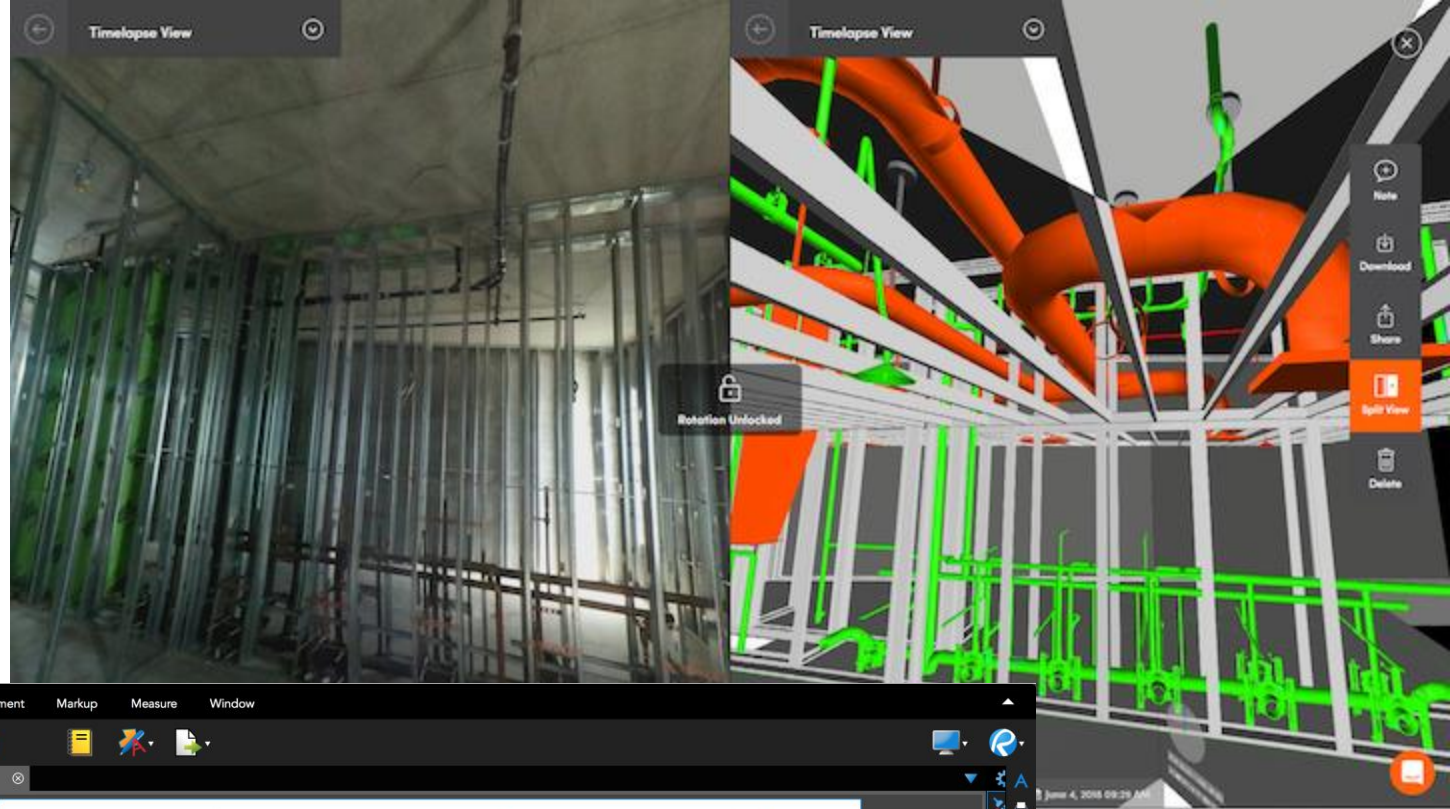
LG 360 = \$99



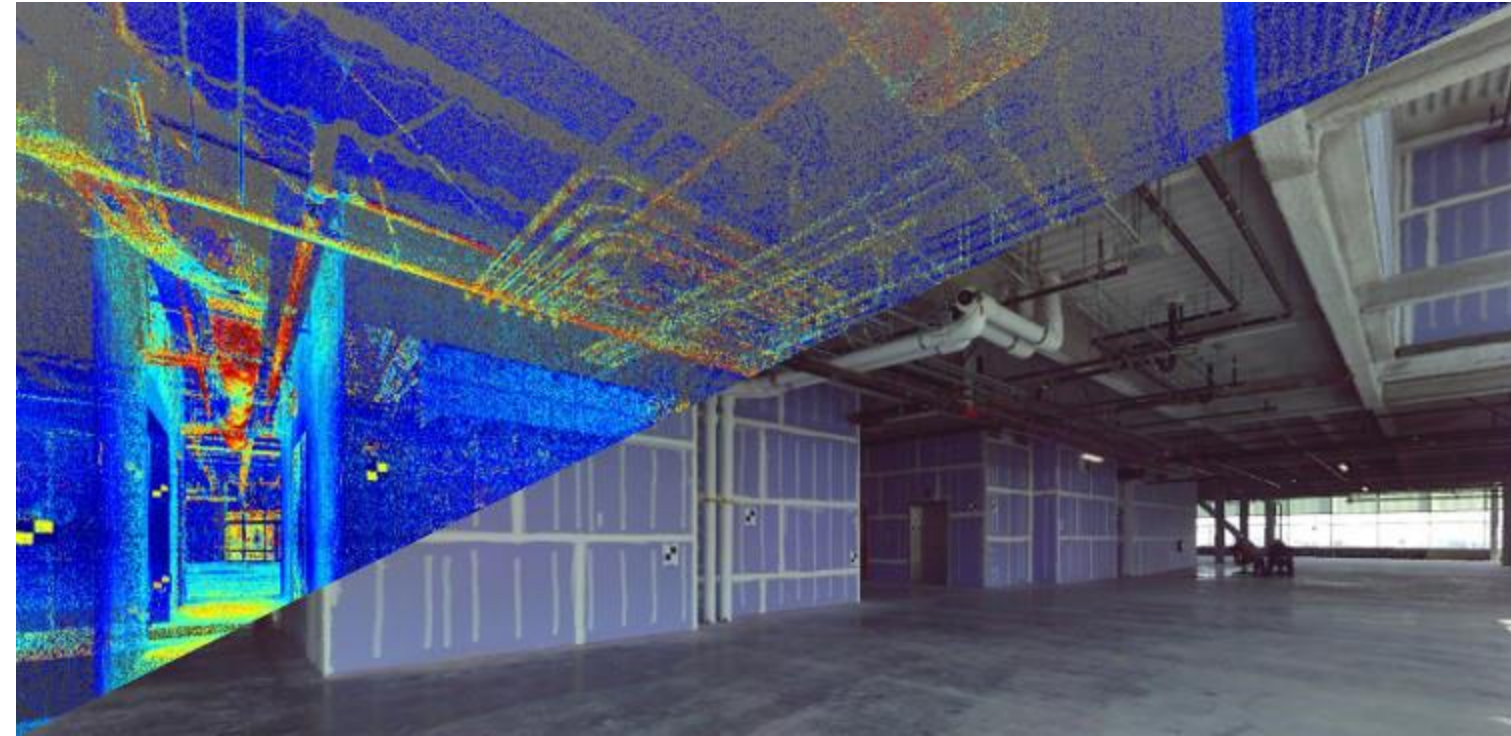
Jobsite Photos



STRUCTIONSITE



Reality Capture



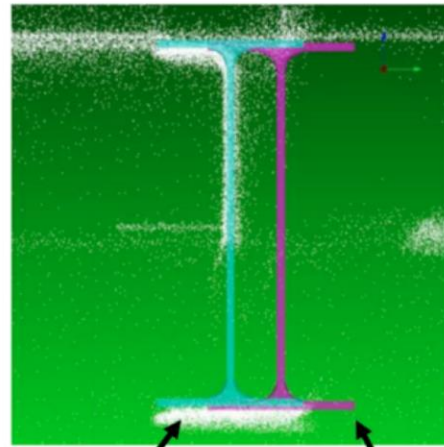
Reality Capture

What Verity Does



- 3 Hours to Process
- 8 Hours to QA and Create PDF Report
- ~50% of Steel was installed out of tolerance, 8% required follow up
- Initial results found some Steel Members 3" out of Place

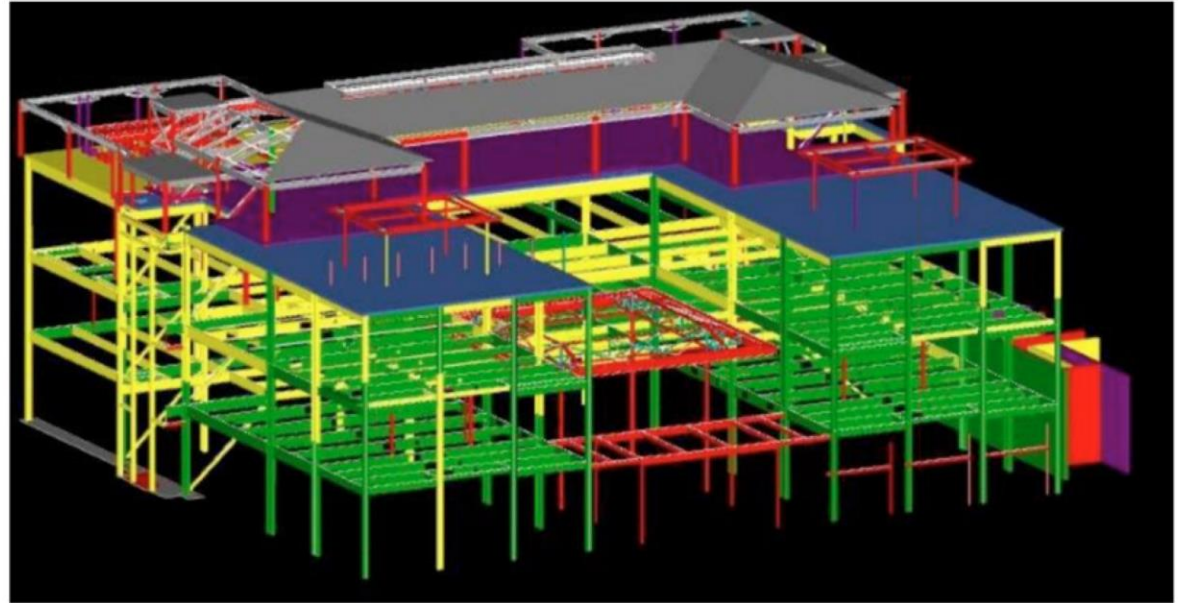
Interrogate each element in Verity



As built

As designed

View the entire project in Navisworks



● = out of tolerance

● = missing

● = present and in tolerance

● = occluded



Education

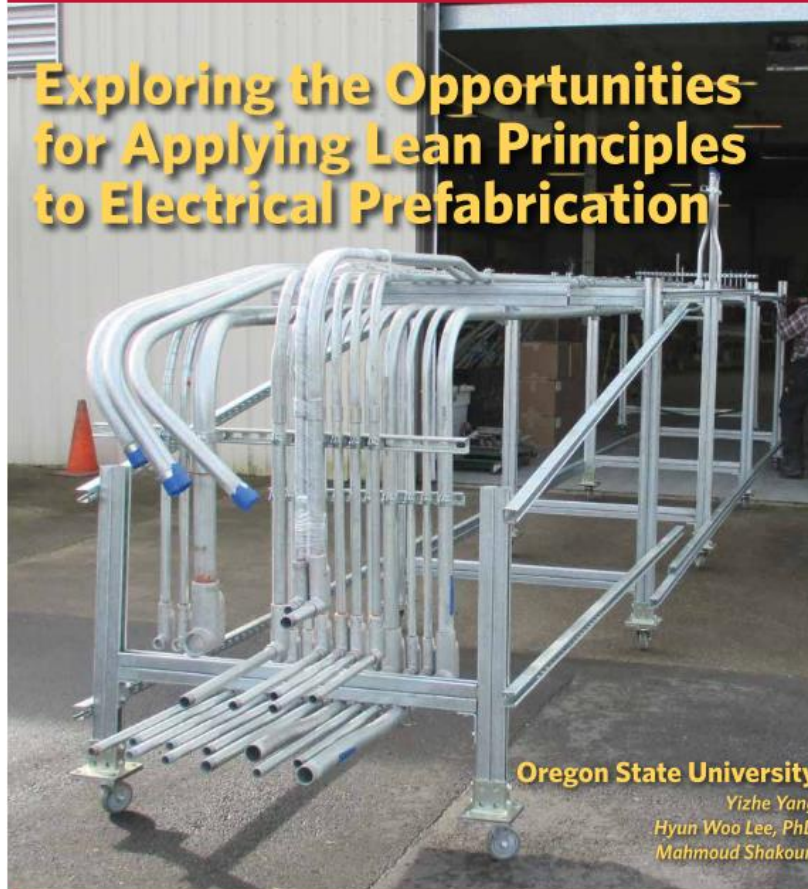


Prefab Research – ELECTRI.org

ELECTRI International—The Foundation for Electrical Construction, Inc.

ORGANIZATIONAL DEVELOPMENT

Exploring the Opportunities for Applying Lean Principles to Electrical Prefabrication



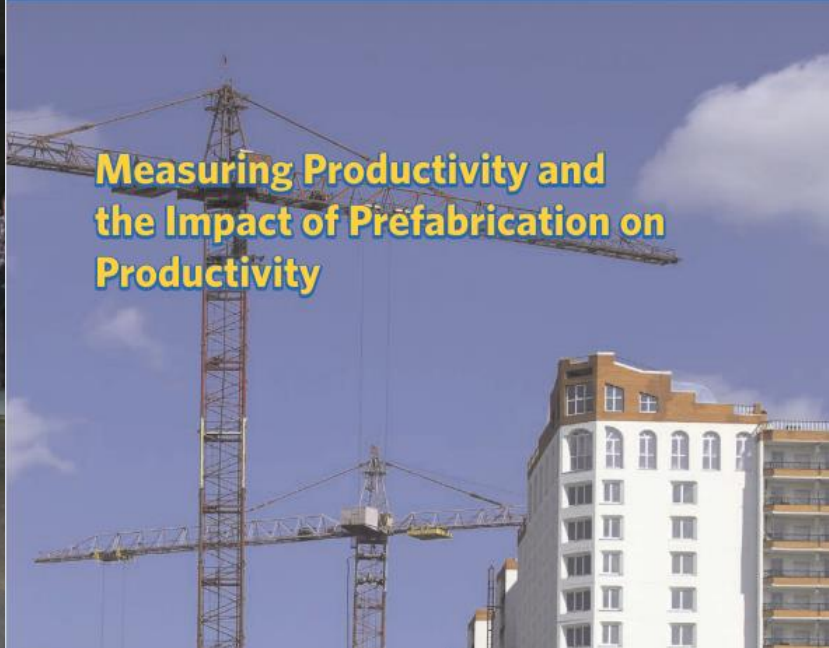
Oregon State University

Yizhe Yang
Hyun Woo Lee, PhD
Mahmoud Shakour

ELECTRI International—The Foundation for Electrical Construction, Inc.

PRODUCTIVITY ENHANCEMENT

Measuring Productivity and the Impact of Prefabrication on Productivity

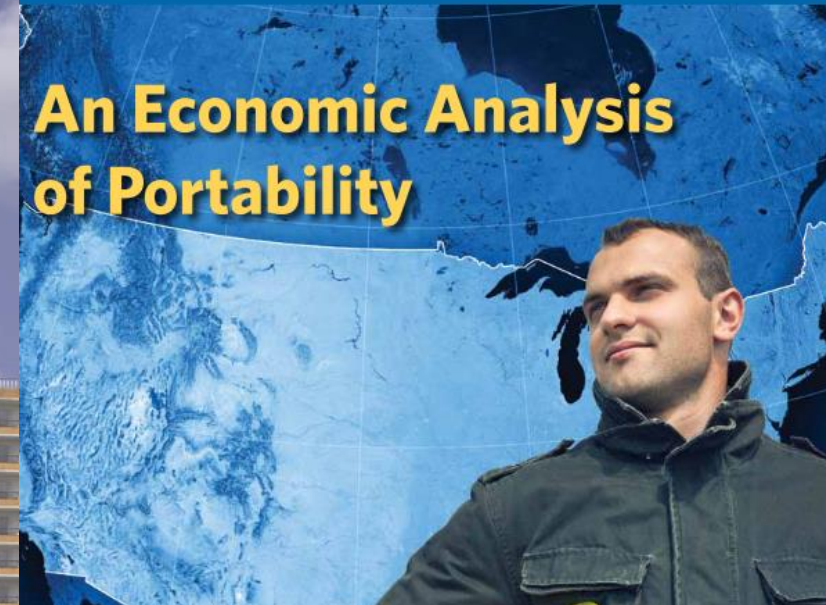


- Labor savings of up to 50% on in-wall, rough-in installation costs.
- Material savings of up to 40%.
- Reduced material handling and inventory costs by building (or ordering) based on the quantities needed for the job and the ability to supply the labeled assemblies in exact quantities.
- Reduced on-site packaging and waste by identifying specific locations on the job to deliver prefabricated materials, thus allowing utilization of palletized assemblies.

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PRODUCTIVITY ENHANCEMENT

An Economic Analysis of Portability



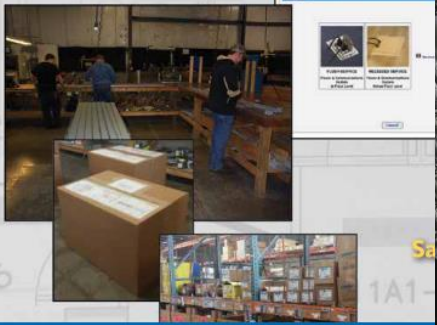
Industrialization Report

ELECTRI International—The Foundation for Electrical Construction, Inc.

PRODUCTIVITY ENHANCEMENT



Industrialization of Electrical Contracting: Prefabrication and Supply Chain



ELECTRI International—The Foundation for Electrical Construction, Inc.

SPECIAL REPORT — PRODUCTIVITY ENHANCEMENT

Industrialization of Construction® A Compilation to Lead the Way, Book 2

Operational Model Needed to Compete in Industrialized Construction



MCA, Inc.
Dr. Perry Daneshgari
Dr. Heather Moore



ELECTRI  **INTERNATIONAL**
Research and Education for the Electrical Construction Industry



Industrialization Index Self-Evaluation

ELECTRI International asked MCA, Inc. to study and identify how Industrialization of Construction® will continue to unfold and provide ELECTRI and its members a means of getting and staying ahead. The Industrialization Index Self-Evaluation looks at each step of Industrialization and ask questions to identify where an organization falls in terms of Industrialization.

* Required

First and Last Name *

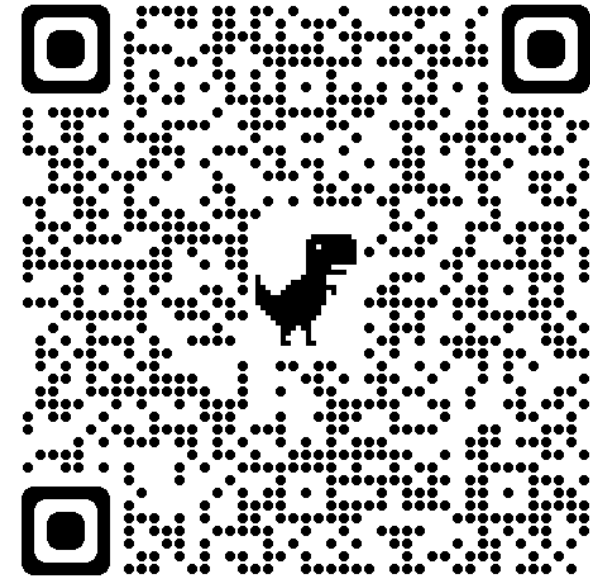
Your answer

Email Address *

Your answer

Company Name *

Your answer





QR Codes to Streamline Data to the Field



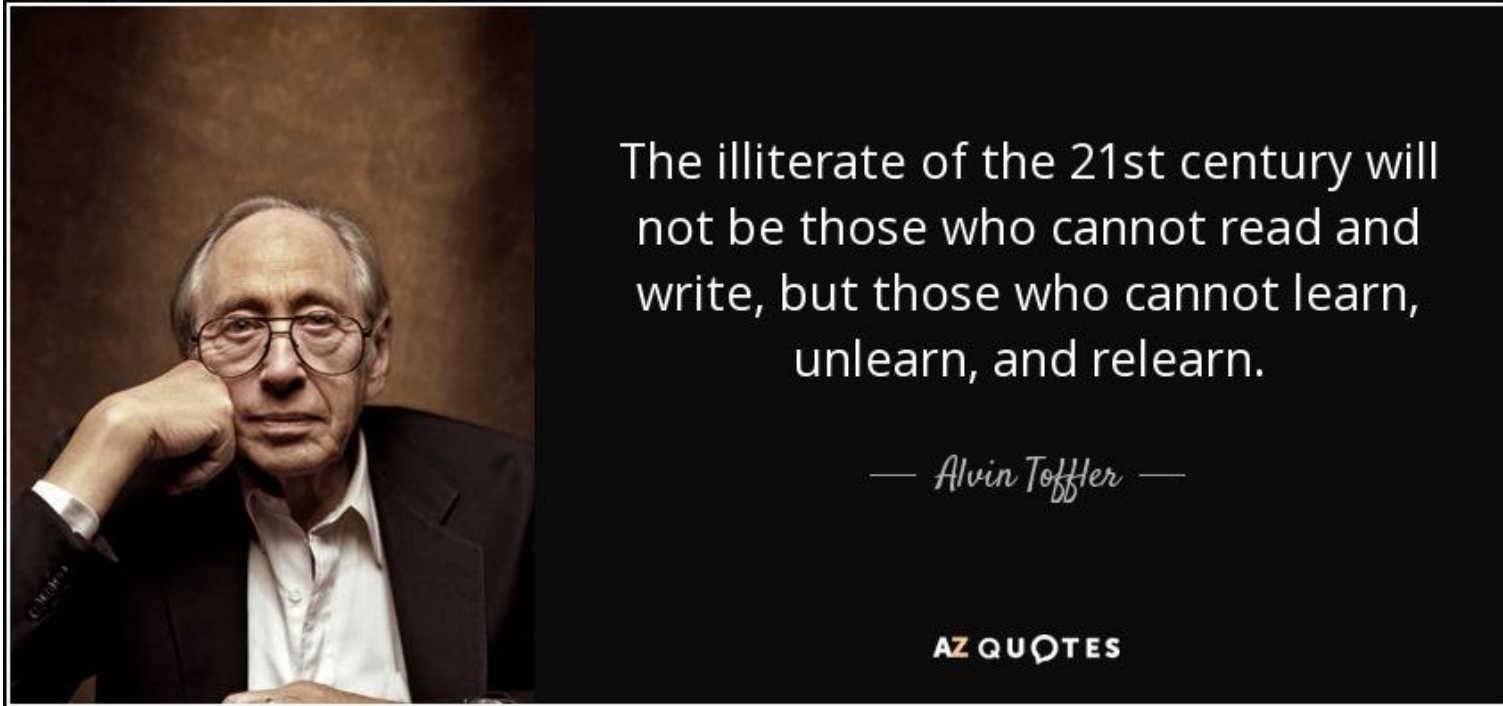


Links to Resources

[Bluebeam training.mp4](#)

[Creating QR Codes.mp4](#)







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